

Generative AI for Transformative Healthcare: A Comprehensive Study of Emerging Models, Applications, Case Studies, and Limitations

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Abstract

Generative artificial intelligence (GAI) can be broadly described as an artificial intelligence system capable of generating images, text, and other media types with human prompts. GAI models like ChatGPT, DALL-E, and Bard have recently caught the attention of industry and academia equally. GAI applications span various industries like art, gaming, fashion, and healthcare. In healthcare, GAI shows promise in medical research, diagnosis, treatment, and patient care and is already making strides in real-world deployments. There has yet to be any detailed study concerning the applications and scope of GAI in healthcare. Addressing this research gap, we explore several applications, real-world scenarios, and limitations of GAI in healthcare. We examine how GAI models like ChatGPT and DALL-E can be leveraged to aid in the applications of medical imaging, drug discovery, personalized patient treatment, medical simulation and training, clinical trial optimization, mental health support, healthcare operations and research, medical chatbots, human movement simulation, and a few more applications. Along with applications, we cover four real-world healthcare scenarios that employ GAI: visual snow syndrome diagnosis, molecular drug optimization, medical education, and dentistry. We also provide an elaborate discussion on seven healthcare-customized LLMs like Med-PaLM, BioGPT, DeepHealth, etc., Since GAI is still evolving, it poses challenges like the lack of professional expertise in decision making, risk of patient data privacy, issues in integrating with existing healthcare systems, and the problem of data bias which are elaborated on in this work along with several other challenges. We also put forward multiple directions for future research in GAI for healthcare.